

# Temporal Changes in Land Use Pattern in the Benue River Floodplain and Adjoining Uplands at Makurdi, Nigeria

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## Abstract

Intensive rural development programmes coupled with state creation have engendered the remarkable transformation of many rural communities into rapidly growing urban centres in Nigeria. Most affected are the small towns which became the capitals of the new states. Makurdi, the capital of Benue State, is one of them.

Makurdi and its environs were studied to assess the land use changes that had occurred between 1967 and 1980 for which the photographs were available.

The study revealed that the use of remote sensing data with particular regard to soil conditions have been insufficient or non-existent in planning urban development in Makurdi. The sub-urban town had expanded rapidly with much of the development spilling into the Benue River floodplain, which contains the best agricultural soils. The floodplain soils are vital for dry season cropping and hence food production for the town.

The conversion of good agricultural land to urban dwellings and other non-agricultural uses is not peculiar to Makurdi town as other newly created state capitals are equally affected. Therefore, the situation calls for local, state and national policies on comprehensive land use planning in developing urban centres so as to protect vital agricultural lands, such as floodplain (or *fadama*) against other competing uses, especially in the sub-humid and semi-arid regions of Nigeria.

## Introduction

Nigeria has recorded three periods of state creation since independence in 1960 with the central idea of creating as many administrative and political divisions as needed to facilitate the rapid socio-economic development of the country. The three periods were 1967, 1976

and 1991 during which some rural towns and villages, that became state capitals, experienced rapid growth owing to the influx of people to service public, private and industrial establishments. Often the development represented a major shift in land use in favour of urban development in dominantly rural communities with an agricultural economy.

Of particular interest are the newly created capitals that are located adjacent to major floodplains in the sub-humid and semi-arid regions. Makurdi, the capital of Benue State, which was created in 1976, has been selected for study.

## **The study area**

Makurdi (centre at 7°44' N, 8°32' E) is a suburban town, which trails the banks of the Benue River, one of the major rivers in Nigeria. It is divided into northern and southern sections by the river, which is bordered on both banks by a floodplain of varying width. It is at an elevation of about 93 meters above sea level in a sub-humid tropical climate, characterized by a distinct dry season of about four months and by Southern Guinea Savanna vegetation. The rainy season occurs between April and November. The mean annual precipitation is about 1370 mm and has a bimodal pattern.

The floodplain and its enclosed river are flanked by Cretaceous sediments: the Makurdi sandstone in the south and the Keana sandstone in the north (FAGBAMI and VEGETALAN, 1985). The floodplain is filled with Quaternary heterogeneous sediments.

In the town, traditional dwellings blend haphazardly with modern residential and commercial buildings. With the town rapidly sprawling on both the sandstone uplands and the floodplain, there is a growing concern among farmers, living within and at the periphery of the town, about the escalating loss of agricultural to urban land.

Therefore, the objectives of the study were:

- Evaluate the direction and extent of land use changes in the Makurdi environs from 1967;
- Demonstrate the applicability of the temporal character of remotely sensed data to the evaluation of land use changes;
- Highlight the usefulness of aerial photographs and interpreted information derivable therefrom in planning the balanced development of urban areas in Nigeria in general and in Makurdi environs in particular.

## **Materials and methods**

Two sets of panchromatic (black and white) aerial photographs (23 cm square contact prints) for 1967 and 1980 were employed in the study. The 1967 aerial photographs are at a scale of 1:40,000, while the 1980 aerial photographs are at a scale of 1:10,000.

The landforms and land use patterns were interpreted and mapped with the aid of the mirror stereoscope. The interpreted data were transformed to appropriate base maps, using the pantograph. Detailed groundtruthing was done in a sample area of 18.8 km<sup>2</sup> to characterize the component soil units in the different landforms, document the cultural features shown on both the 1967 and 1980 aerial photographs and investigate the additional changes in land use, that had occurred between 1980 (representing the most recent aerial photography of the area) and the present.

Knowledge of the Makurdi town and environs, gained by one of the authors during an ecological survey of soils and grasslands in 1975 under the Atomic Energy Biosphere programme, was applied in further highlighting when development actually became intensified in the period 1967-1980.

## **Results and discussion**

### **Land use and temporal changes**

In 1967, Makurdi was a very small town (Fig. 1), serving as a railway station and a transit town between the north and south of the country.

Much of the floodplain of the River Benue and the adjoining uplands were farmlands. The floodplain was used mainly for production of rice in the rainy season and for vegetables (edible leaves, tomatoes, okra and onions) in the distinct dry season. The floodplain is narrowest in the Makurdi environs, but becomes much wider (between 5 km and 8 km wide on the north and south banks of the river) east and west of the town.

By 1967, only a small portion of the land had been built up both on the southern and northern banks of the river (Table 1), the main structures being the railway quarters, some small residential areas, the road network and railway bridge (Fig. 1).

By 1975, not much expansion of the town had occurred and the main communication links between the north and south portions of the town remained the railway bridge and canoes. However, marked changes began in 1976 when Makurdi became the capital of the newly created Benue state. From that year, a rapid urban development ensued, spurred by the intense public and private land development activities for residential military and industrial purposes.

The development affected both the uplands and the floodplain. Worthy of emphasis is the encroachment of non-agricultural land use into the floodplain. A zoo cum recreational area, some institutions, residential quarters and a brewery had consumed portions of the floodplain south of the river. North of the river, the town had extended markedly into the floodplain with the development of a housing estate, a new road which is linked to the south bank of the river by a new bridge and some residential traditional quarters (Fig. 2).

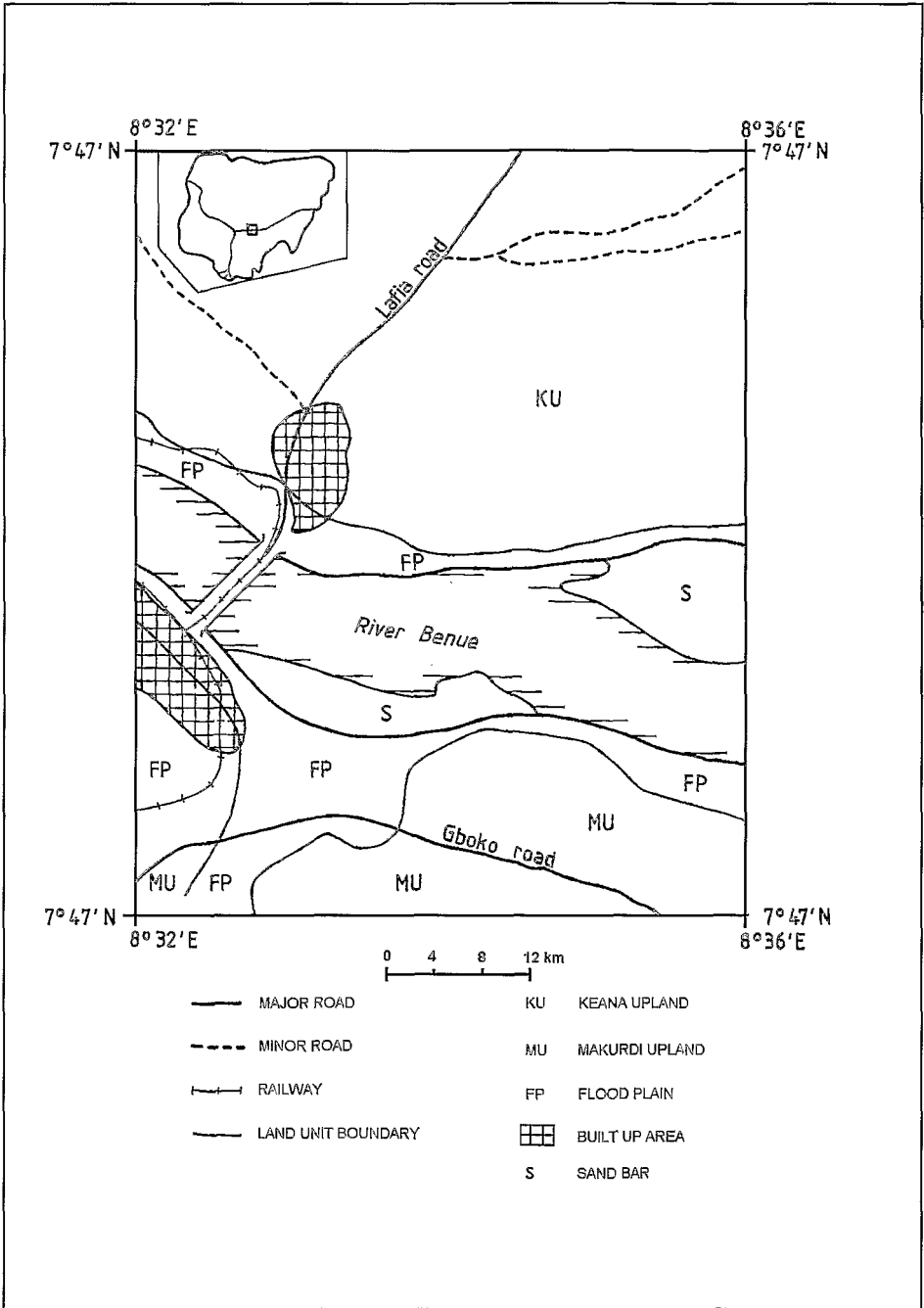


Figure 1. Land use map of Makurdi environ (1967).

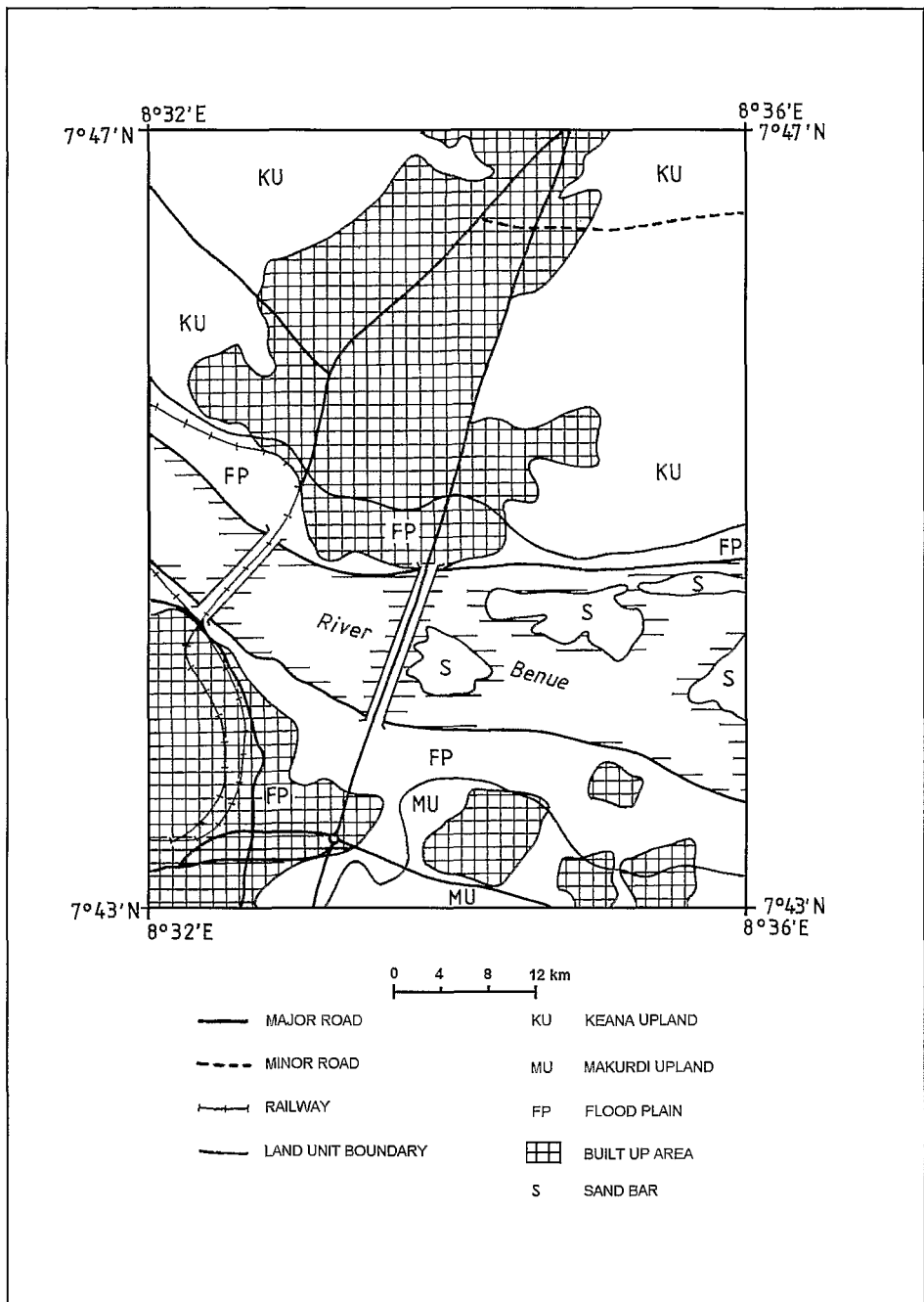


Figure 2. Land use map of Makurdi environ (1980).

**Table 1.** Land use trends in a sample area of the Benue valley at Makurdi, 1967-1980.

Land use categories	1967 (ha)	1980 (ha)
Area occupied by Benue River	390	416
Area occupied by floodplain	177	152
Upland area adjoining floodplain	<b>1315</b>	<b>1304</b>
Total land area	1882	1882
Built-up area	45	605
Built-up area (% of total)	2.4%	32.1%

Generally the built-up area (that is amount converted to non-agricultural uses) in Makurdi increased from about 21% in 1967 to about 32% of the total land area in 1980 (Table 1). Considering the floodplain alone, the amount of it that had been built-up increased from about 7% in 1967 to about 41% in 1980 (Table 2).

Presently a substantial part (estimated at more than 50%) of the land area in the Makurdi environs has been converted to urban use. Regarding the floodplain, only very narrow strips of it are left; however, a relatively large expanse of it is available to the east and west of the town. Currently, the intensive use of the remaining floodplain at Makurdi by local farmers for rice (in the rainy season) and for vegetable (in the dry season) production is being sponsored by the state government through its extension agency, the Benue State Agricultural and Rural Development Authority (BNARDA). However, the farmers face the risk of losing the remaining floodplain to residential or other uses unless the Benue State Government takes steps to protect this area and those portions to the east and west of the town as well.

### Soil quality as guide to land use

The alluvial soils of the floodplain, though heterogeneous, are superior agriculturally to the adjoining upland soils derived from sandstones. They are generally heavier textured than the upland soils. They classify as Eutric Fluvisols, Luvisols (Orthic and Vertic subgroups), Nitosols and Cambisols (Gleyic and Vertic subgroups), whereas the upland soils are Acrisols (Ortic and Ferric subgroups) and Dystric Cambisols (FAO-UNESCO, 1974; FAGBAMI and AKAMIGBO, 1986). The higher water and nutrient retaining capacities, higher inherent fertility and availability of moisture in the horizons above the water table in the dry season make the floodplain areas sites for all-year-around cultivation and therefore food production for the increasing population. On the other hand, the better drained upland soils have predominantly low activity clay fractions [kandic property], low to medium base status and low water and nutrient retaining capacities like most other upland soils of the sub-humid region (LAL, 1983).

**Table 2.** Level of encroachment on the floodplain in a sample area at Makurdi by urban development activities, 1967-80.

Land types	1967 (ha)	1980 (ha)
A. Floodplain areas		
i. South Bank	128	114
ii. North Bank	49	38
Total	177	152
B. Built-up area	12	63
C. Built-up area as % of floodplain area	6.8%	41.4%

Regarding the floodplain soils, the problems of wetness, low permeability and frequent periodic flooding hazards make them highly unsuitable as on-site septic tank, sewage disposal fields and for structures such as buildings and roads. These adverse properties of the floodplain soils have not been considered in the conversion of the floodplain into building sites in the Makurdi environs.

### **Urban development without land use planning**

The development of the Makurdi environment into a suburban centre from 1967, a process which became intensified from 1976, has not been based on a comprehensive land use planning as is commonly done in the developed countries (DOYLE, 1966).

A comprehensive land use planning as a basis for the town's development would have ensured the integral use of the land area in which provision would have been made, based on soil and other landscape qualities, for areas to be developed as urban sites, agricultural land, open space, recreational sites and conservation sites for special needs within and at the urban-rural periphery of the town.

Moreover, potential conflict areas, such as the floodplain would have been identified and steps taken to guide their use. In this regard, the floodplain would have been zoned to agricultural use and declared as a "Floodplain Conservation Area" by ordinance.

It is important to state, that the government at national level introduced the World Bank-assisted Fadama Agricultural Development Project nationwide as one of the strategies to boost food and agricultural production. The floodplains are the land base for the project, wherever they occur. Therefore, the need to declare them Floodplain Conservation Areas in support of the project is apparent, especially with regard to the sub-humid and semi-arid regions.

Currently, the encroachment on prime agricultural lands by urban development is not peculiar to the Makurdi environs. It occurs in other towns and cities developing along the banks of rivers, having extensive floodplain and/or fertile upland soils. Only a policy of comprehensive land use planning for urban development at all levels of government can protect such agricultural lands from other uses.

The usefulness in land use planning of aerial photographs and their interpretations to reveal slope and soil conditions, trends of land use changes within urban areas and their peripheries (RYERSON *et al.*, 1982; LARRY *et al.*, 1988) and other derived landscape information cannot be over-emphasized. Soil survey data, usually acquired in modern times with the aid of remote sensing techniques (as for example interpretation of aerial photographs) are equally useful for planning urban development. Regrettably, these information resources, especially soil survey data that are available (BENNETT *et al.*, 1976; FDALR, 1985), have not been utilized in fashioning a balanced development of Makurdi as an urban centre. Since the town is still growing and spreading along the River Benue on both banks, it is advisable that further development should be guided by a comprehensive land use plan aided by remote sensing techniques. Part of that plan will be to protect the floodplain from other than agricultural uses.

## Conclusions

Intensive rural development programmes coupled with state creation in 1967, 1976 and 1991 have engendered the remarkable transformation of many rural communities into rapidly growing urban centres. These centres, Makurdi being an example, are developing without the support of comprehensive land use planning, aided by remote sensing techniques and data in which land is zoned as based on qualities, to different uses without the towns and their peripheries meeting socio-economic needs of the populations. The result is that urban land use often encroaches on vital or prime agricultural lands, such as has occurred in the Makurdi environs with respect to the floodplain of the River Benue. To reverse this trend into land use change, it is recommended that a comprehensive land use planning will be undertaken for the Makurdi environs and other towns that border floodplains especially in the sub-humid and semi-arid regions of the country.

Floodplains should be declared by government policy and ordinance as "Floodplain Conservation Areas", especially reserved for agricultural uses in support of the recently introduced Fadama Agricultural Development Project nationwide.

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